Test of unmanned surface vehicles to conduct remote focal follow studies of a marine predator

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Text S1.

MATERIALS & METHODS

Saildrone location data filtering

The location data were filtered to remove erroneous locations that could send the Saildrone off track of the actual fur seal foraging path. Saildrone removed transmitted GPS locations (2016) with residuals greater than 50 (manufacturer quality index) (Dujon et al. 2014) and satellite locations (2017) with a Z quality class or an error ellipse radius of greater than 1500 m (Costa et al. 2010, Dujon et al. 2014). In 2017, a speed filter of greater than 3.0 m s^{-1} was applied to all remaining locations except those with a quality 2 or 3 (Costa et al. 2010).

Saildrone equipment specifications

Oceanographic and atmospheric parameters were recorded at 1, 5, or 10 minute intervals and data were transmitted in near real time via Iridium. The Saildrone measure variables including incoming photosynthetically active solar radiation (PAR, 2016 only), wind speed and direction, relative humidity, barometric pressure, air and water temperature, salinity, dissolved oxygen, chlorophyll fluorescence, and colored dissolved organic matter (CDOM) fluorescence (Cokelet et al. 2015, Mordy et al. 2017). The Saildrones were also instrumented with a calibrated Simrad WBT-mini or WBAT split-beam echosounder (Kongsberg

Maritime, AS) equipped with a 70 kHz (2016) or 38 kHz (2017) 18° beamwidth transducer (De Robertis et al. 2019).

RESULTS

Average wind speed recorded from the Saildrones during the focal follow periods ranged from 4.9 to 9.3 m s^{-1} and the Saildrones' speed ranged from 0.9 to 1.3 m s^{-1}. The speed measurements included periods when the Saildrone was waiting for the next fur seal location. Fur seals transit rates ranged from 0.57 ± 0.07 to 0.86 ± 0.06 m s^{-1} over the focal follow periods (mean: 0.71 ± 0.13 m s^{-1}), with maximum transit rates up to 2.6 m s^{-1}.

LITERATURE CITED

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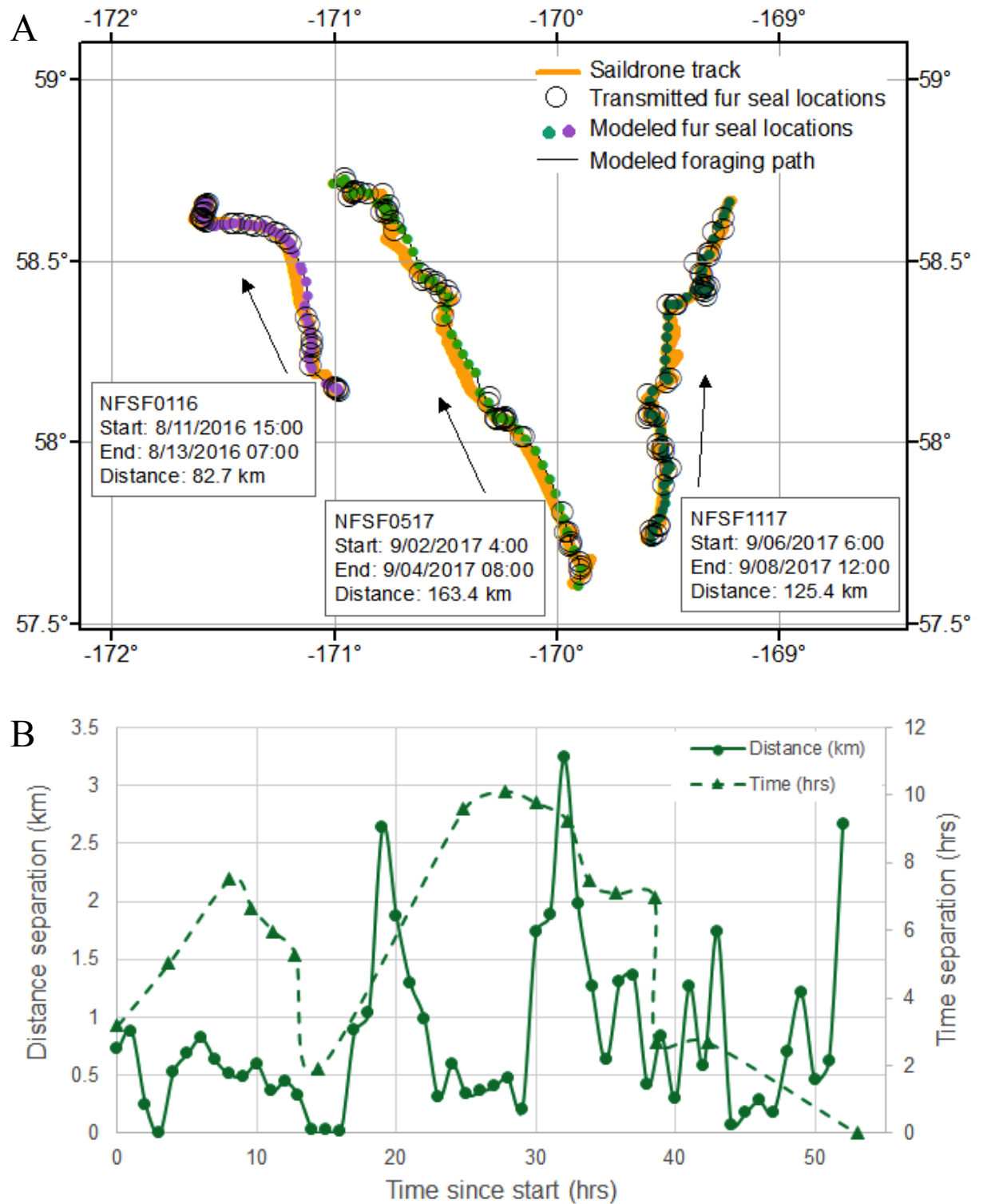
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FIGURES

Figure S1: A) Detailed maps of 3 representative focal follows. The Saildrone (solid orange line) followed transmitted locations from tracked fur seals (open circles). Due to differences

in instrument types, in 2016, fur seal transmitted locations were the most recent GPS location, whereas in 2017, satellite locations were used to conduct focal follows. Performance metric calculations were based on modelled fur seal foraging paths created using archived GPS locations (purple points, 2016) or filtered satellite locations (green points, 2017). Arrows denote direction of travel. B) Example of focal follow performance metrics, distance of the Saildrone to the modelled fur seal path (solid line, circles) and the time difference at 10 km increments (dashed line, triangles), along a single focal follow (NFSF0517, center focal follow in A).
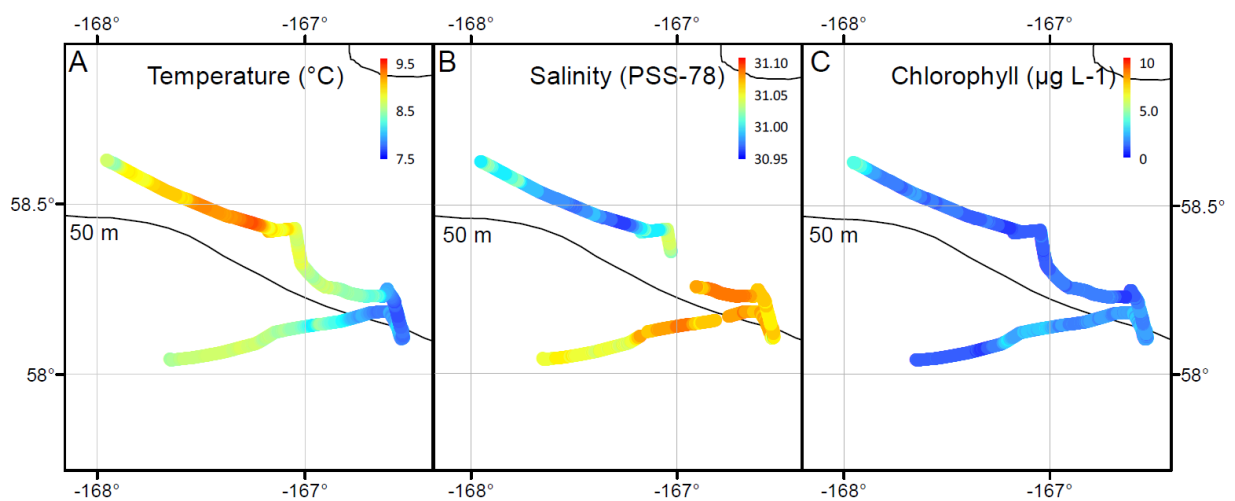

Figure S2: Variability in surface oceanographic conditions measured by a Saildrone during a single focal follow (NFSF0717): surface temperature (A), salinity (B), and chlorophyll (C). Gaps in the salinity data represent times when the measurements were compromised, possibly due to fouling.